The Drowning of a Coastal Estuary: How Hurricanes and Sea-Level Rise Altered Big Sable Creek, Everglades National Park

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Introduction

Big Sable Creek (BSC) is located on the northwest coast of Cape Sable within Everglades National Park, and home to many endangered and threatened species. Between 1928 and 1952, BSC transitioned from a small series of tidal creeks to a highly channelized network of creeks, mudflats and mangrove islands. The Labor Day Hurricane of 1935 caused major damage to the Florida Keys and is believed to have caused the transformation of BSC. Two lesser, no-named storms in 1929 and 1935 may have contributed. Very little, if any recovery has occurred since 1935 due to additional hurricane impacts and current sea-level rise. Hurricane Donna (1960), Andrew (1992), and Wilma (2005) impacted the area with high winds, storm surges, and sediment deposition increasing tree mortality and preventing recovery. Without adequate seed recruitment and sediment supply (leaf litter, root debris, and occasional storm deposits), the mangroves that occupy this region will retreat inland or die off.

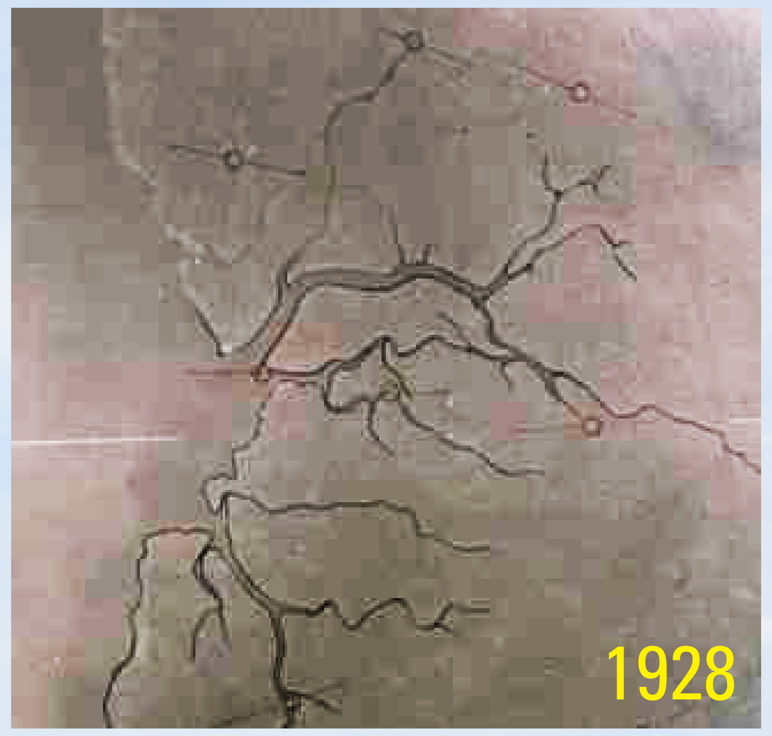

Figure 4. Big Sable Creek aerial imagery from 1928. (Courtesy of the U.S. Army Air Corps.)

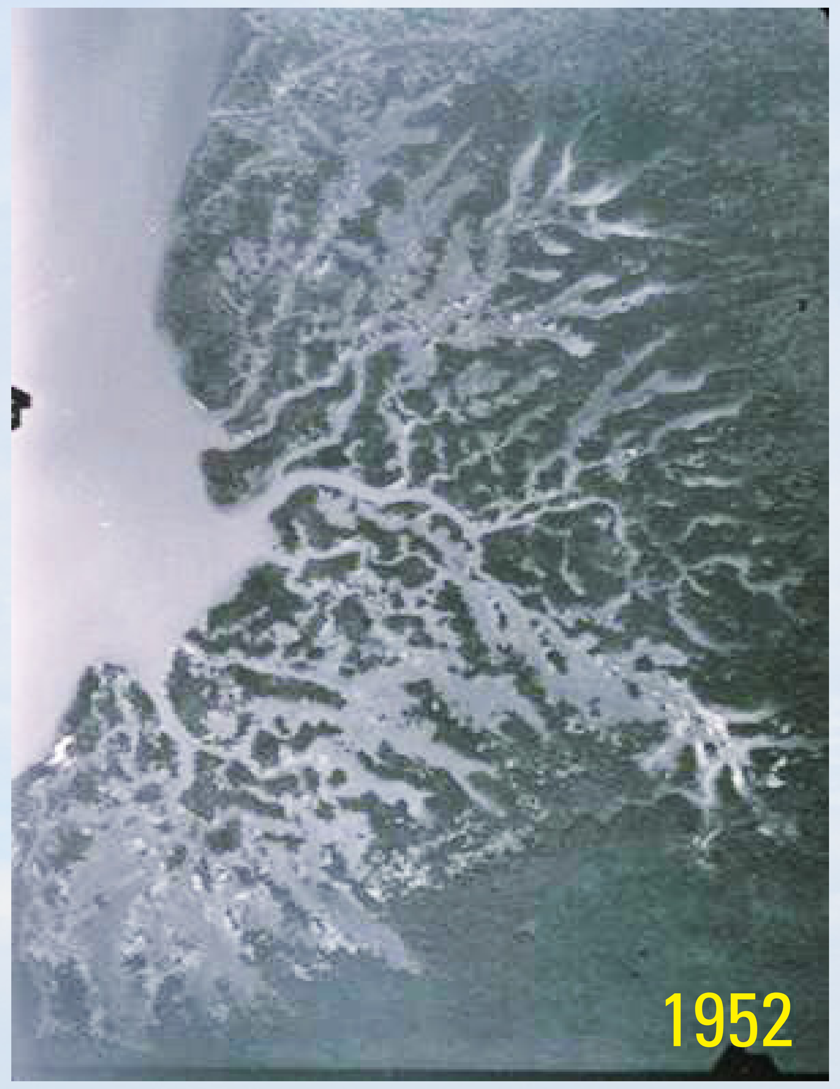

Figure 5. Big Sable Creek aerial imagery from 1952. Vast areas of mudflats have formed since 1928. (Courtesy of the USGS and EROS Data Center.)

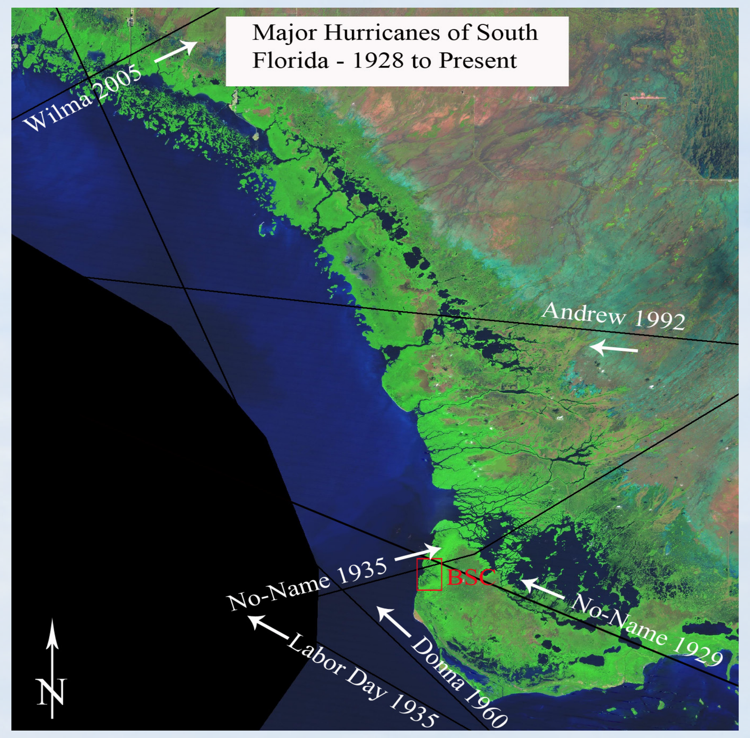

Figure 6. Six Major Hurricanes affected the Big Sable Creek area between 1928 and Present. Even though Wilma made land-fall far to the north, the high winds, storm surge, and sediment deposition were strongest within this region. Very little data exists from the no-named storms of 1929 and 1935, but their timing and storm tracks suggest they contributed to tree mortality within Big Sable Creek.

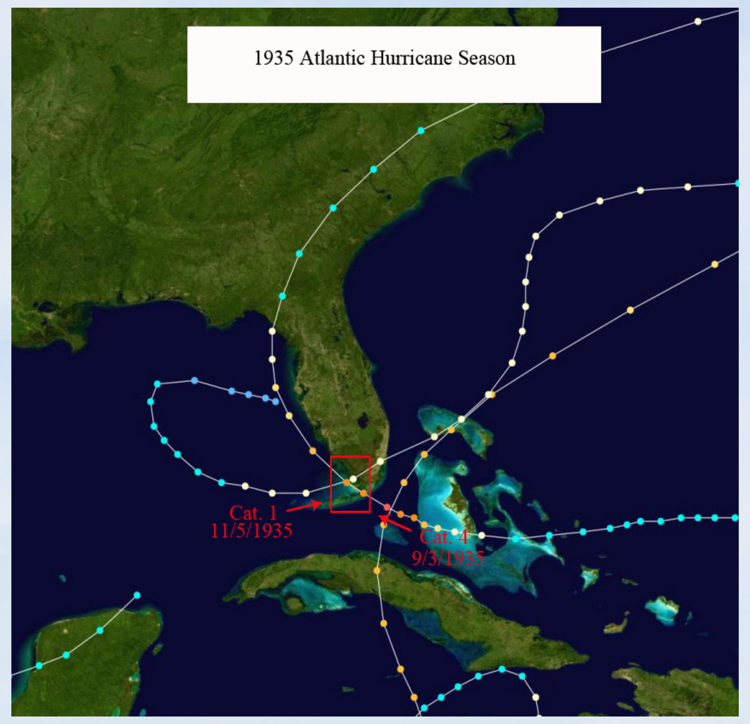

Figure 7. The Labor Day Storm of 1935 is believed to have been the major contributor to altering in Big Sable Creek, but the no-named storm's direct impact 2 months later must have reinforced the effects.

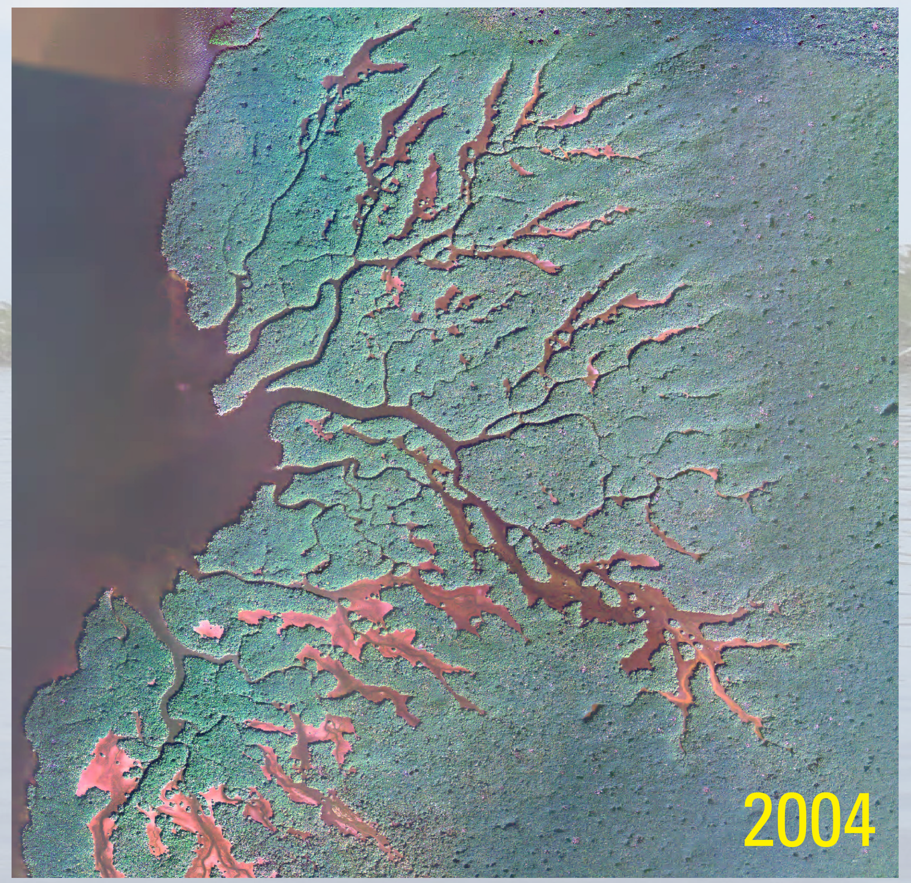

Figure 8. Big Sable Creek Imagery from 2004. (Courtesy of DEP's Land Boundary Information System).

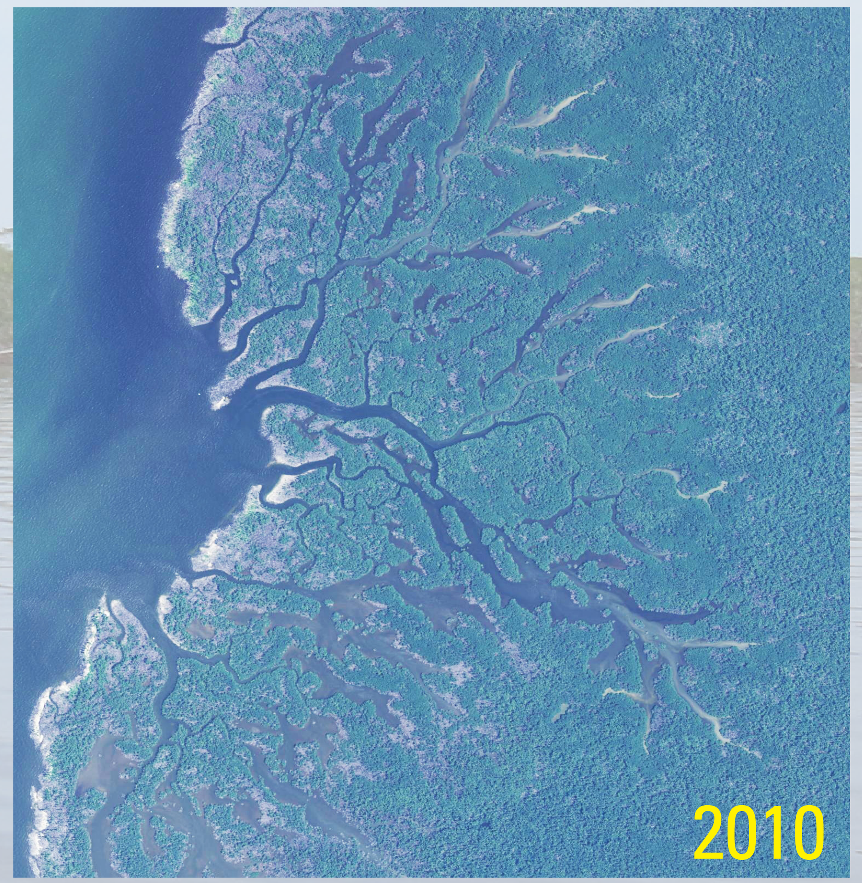

Figure 9. Big Sable Creek Imagery from 2010. The effects of Hurricane Wilma are noticible as brown patches within the mangroves and whites areas along the coast. We expect shoreline migration and considerable increase in mudflats as these trees are uprooted and removed. (Courtesy of USDA's National Agriculture Imagery Program).

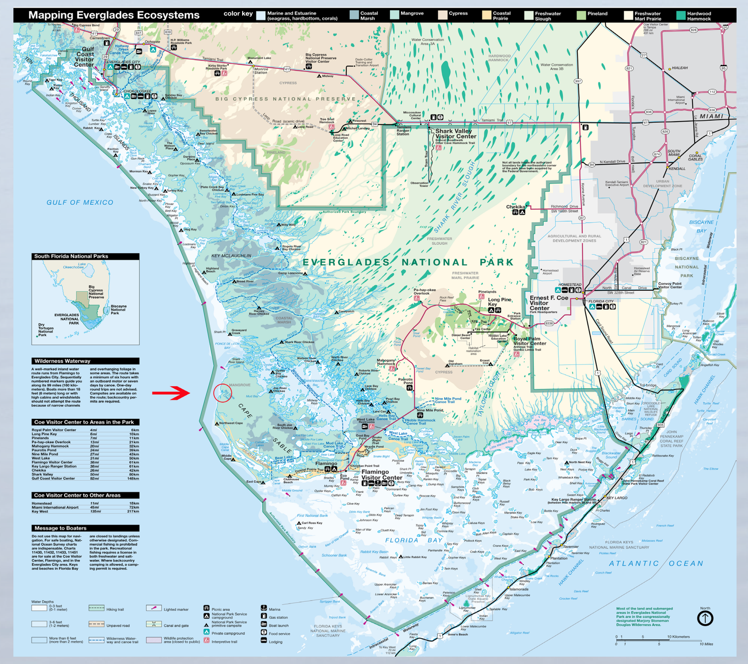

Figure 1. Everglades National Park and the location of Big Sable Creek. (From NPS).

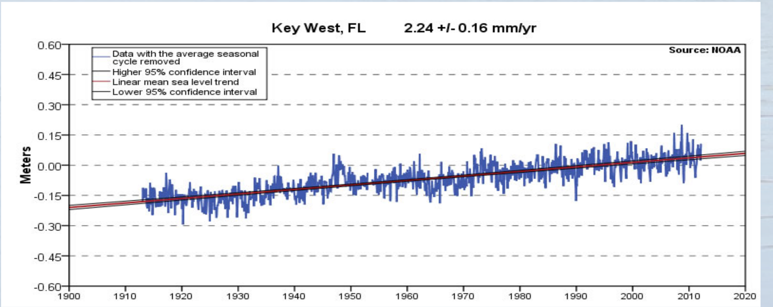

Figure 2. The mean sea level trend is 2.24 millimeters/year with a 95% confidenceinterval of +/- 0.16 mm/yr based on monthly mean sea level data from 1913 to 2006 which is equivalent to a change of 0.73 feet in 100 years. (From NOAA).

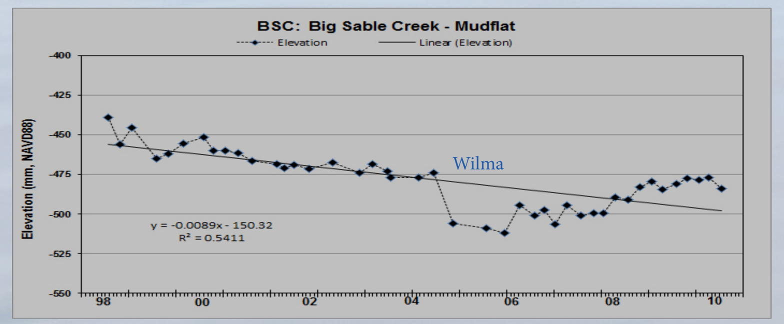

Figure 3. Long-term pattern of surface elevation change for the Big Sable Creek mudflat complex. The surface declined by >30mm following Hurricane Wilma in 2005.

Methods

This area, a mangrove coastline and part of a network of coastal, riverine, and marsh study sites, is the focus of a 13-year study that includes the emplacement of Surface Elevation Tables (SETs), feldspar marker horizons, permanent vegetation plots, and surface and ground water wells. Additionally, the use of historical charts and aerial photographs helped identify coastal habitat change over an 84-year period.

Observations

- Major hurricanes have impacted the Big Sable Creek area between 1928 and present.
- A major transition occurred, converting mangrove shoreline, with few stream channels, to vast areas of mudflats and mangrove islands between 1928 and 1952.
- Inland retreat of shoreline in excess of 300 meters was measured in some areas.
- High tree mortality followed Hurricane Wilma in 2005.
- Soil elevation declined by >30mm following Hurricane Wilma in 2005.
- Limited recovery between major storm events.
- Sea level rose steadily at 2mm yr-1, according to the Western Hemisphere's longest sea-level record at Key West (since 1846).

Conclusions and Future Directions

- The hurricanes impacting Big Sable Creek between 1929 and 1935 shifted the ecosystem from mangroves to mudflats.
- Other storms and sea-level rise have prevented recovery.
- The effects of Hurricane Wilma have yet to become fully realized, but greater areas of mudflats are expected as well as shoreline migration.

- This region is a prime candidate for sediment trapping and stabilization using wattles, sediment fences, and mass seedling transplants.

Acknowledgements

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